RLab 4

Research Methodology – Quantitative

Ultra-small wearables (e.g., smartwatches) can be design challenge due to touch-based text entry. A well-known effect is the so-called *fat-finger problem* wherein users struggle to select elements much smaller than their fingers. In this RLab, we are dealing with a data set containing variables collected in a simple experiment to compare the performances of three ultra-small keyboards (*DriftBoard*, *ZoomBoard*, *Swipeboard*), see also figure 1.

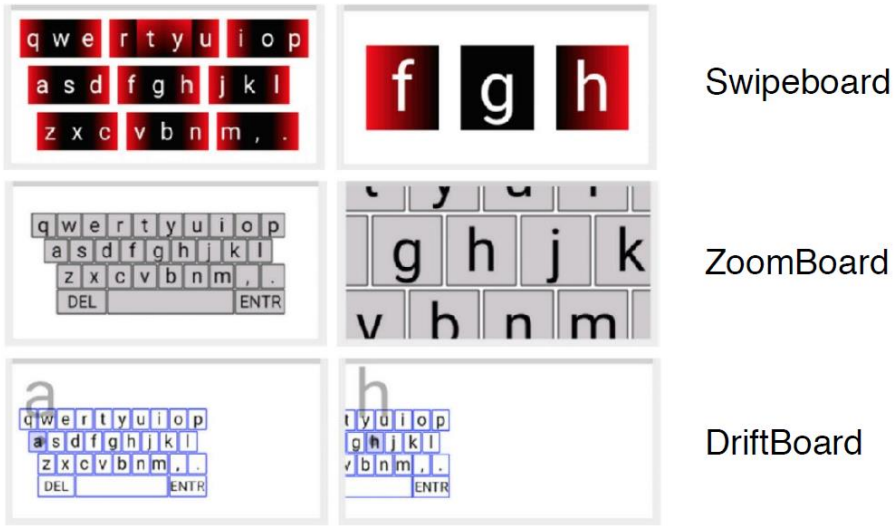

Figure 1. Text entry for ultra-small touchscreen.

The data set contained in the external file (`TEXTETECH.csv`) has the following variables:

- **AGE** a variable with 3 age levels: 1 = [18 - 29], 2 = [30 - 45], 3 = [46 - 55]
- **TET** (text entry technology): ZB (ZoomBoard), DB (DriftBoard), SB (SwipeBoard)
- **TES** (text entry speed as words per minute); TES was calculated by dividing the length of the transcribed text by the entry time (in seconds), then multiplying by sixty (seconds in a minute) and dividing by five (the accepted word length, including spaces).
- **MD** (mental demand scale): 21-point rating scale of the NASA Task Load Index (TLX) survey. High values mean high mental demand (see Figure 2).
- **PD** (physical demand): 21-point rating scale of the NASA Task Load Index (TLX) survey. High values mean high physical demand (see Figure 2).
- **TD** (temporal demand): 21-point rating scale of the NASA Task Load Index (TLX) survey. High values mean high temporal demand (see Figure 2).
- **PER** (performance): 21-point rating scale of the NASA Task Load Index (TLX) survey. High values mean high performance (see Figure 2).
- **EFF** (effort): 21-point rating scale of the NASA Task Load Index (TLX) survey. High values mean high effort (see Figure 2).
- **FRU** (frustration): 21-point rating scale of the NASA Task Load Index (TLX) survey. High values mean high frustration (see Figure 2).

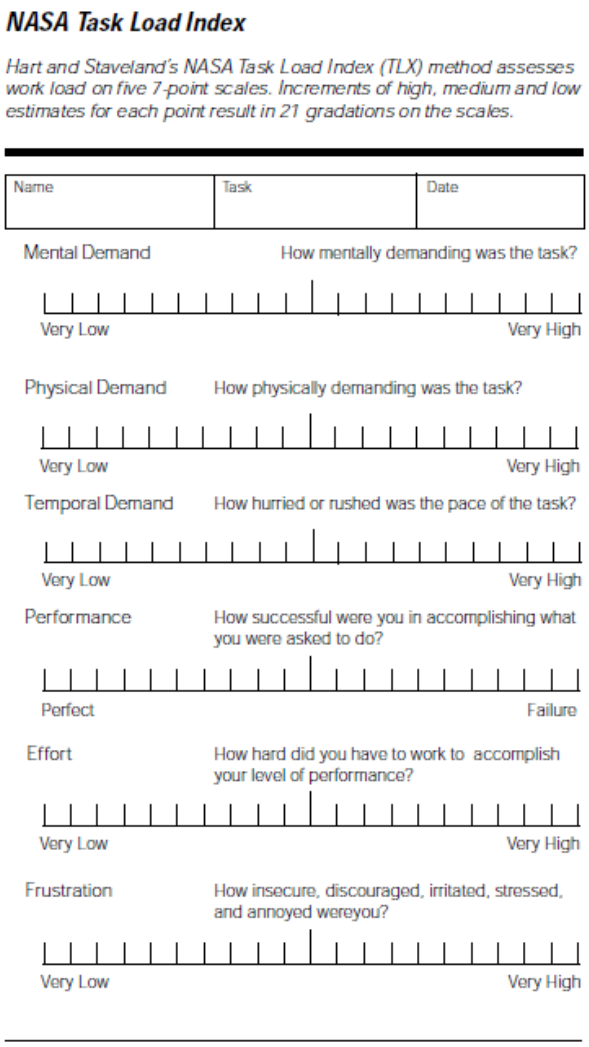

Figure 2. NASA-TLX questionnaire.

Exercise 1.1 Load the data file `TEXTETECH.csv` in the R package and assign it to a data frame called DATA.

Exercise 1.2 Use the `summary` function to describe the content of the quantitative variables. Repeat the analysis by providing boxplot representations.

Exercise 1.3 Run an analysis of variance (ANOVA) model using TES as dependent variable and TET as the only factor (one-factor analysis of variance). Provide appropriate graphical representations and comment the statistical inference results. In case of statistically significant result for the factor TET, run additional post-hoc analyses on the levels of the factor (note: you have to control for the Type I error probability).

Exercise 1.4 Rerun the analysis, this time by considering also AGE as a second factor in the analysis. Provide the new graphical representations and comment the statistical inference results. In case of statistically significant results (note that here you have 3 distinct inferential tests: main effect of TET, main effect of AGE, and interaction effect TET by AGE), run additional post-hoc analyses on the corresponding significant effects (note: you have to control for the Type I error probability separately for each eventual significant effect).

Exercise 1.5 Construct a new variable called COST corresponding (for each participant) to the sum of the variables MD, PD, TD, EFF, and FRU. Run an ANOVA model with COST as the dependent variable and TET

and AGE as the two factors in the analysis. Graphical representations, comments on the statistical results, and eventual post-hoc analyses as for Ex. 1.4.

Exercise 1.6 Repeat the analysis in Ex. 1.5, this time replacing the COST variable with the PER variable in the ANOVA model.